WISENMESHNET® Tilt Node

(Dual-Axis)

User Manual

Wisen Innovation Ltd

July 2014

Revision History and Clarification

Rev.	Issue Date	Revisions	Written By	Revised By
V5.0	20/06/2014	1st Issue	Tony Shi	Yan Wu
V6.0	28/07/2014	2nd Issue	Yan Wu	Brian Jones
V7.0	03/08/2014	3rd Issue	Yan Wu	Ian Wassell
V8.0	06/08/2014	4th Issue	Yan Wu	Ian Wassell

Document Definition:

It defines the specifications (introduction, usage and maintenance method) of the Tilt Node, which is one of the key components in WISENMESHNET® Low Power, Intelligent, Wireless Sensor Network system.

Scope：

Customer Site Project Managers and Engineers, Wisen Services Engineers

Notice：

This documentation provides the basic instructions about the WISENMESHNET® Tilt Node. Any further information can be requested by the customers.

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1. Product Introduction

The WISENMESHNET® Tilt Node is one of the key products in our patented WISENMESHNET® geotechnical safety monitoring system. Working together with the WISENMESHNET® gateway product and node products, it intelligently delivers the real-time tilt deformation of a structure to the information centre.

The WISENMESHNET® Tilt Node operates using our core technology, i.e., the WISENMESHNET® Low Power, Intelligent, Wireless Sensor Network protocol, together with its internal high precision MEMS tilt sensing module and power unit. This product satisfies the three fundamental identities of the system:

A. Network Life Span: to maximise battery life across the mesh network as a whole;

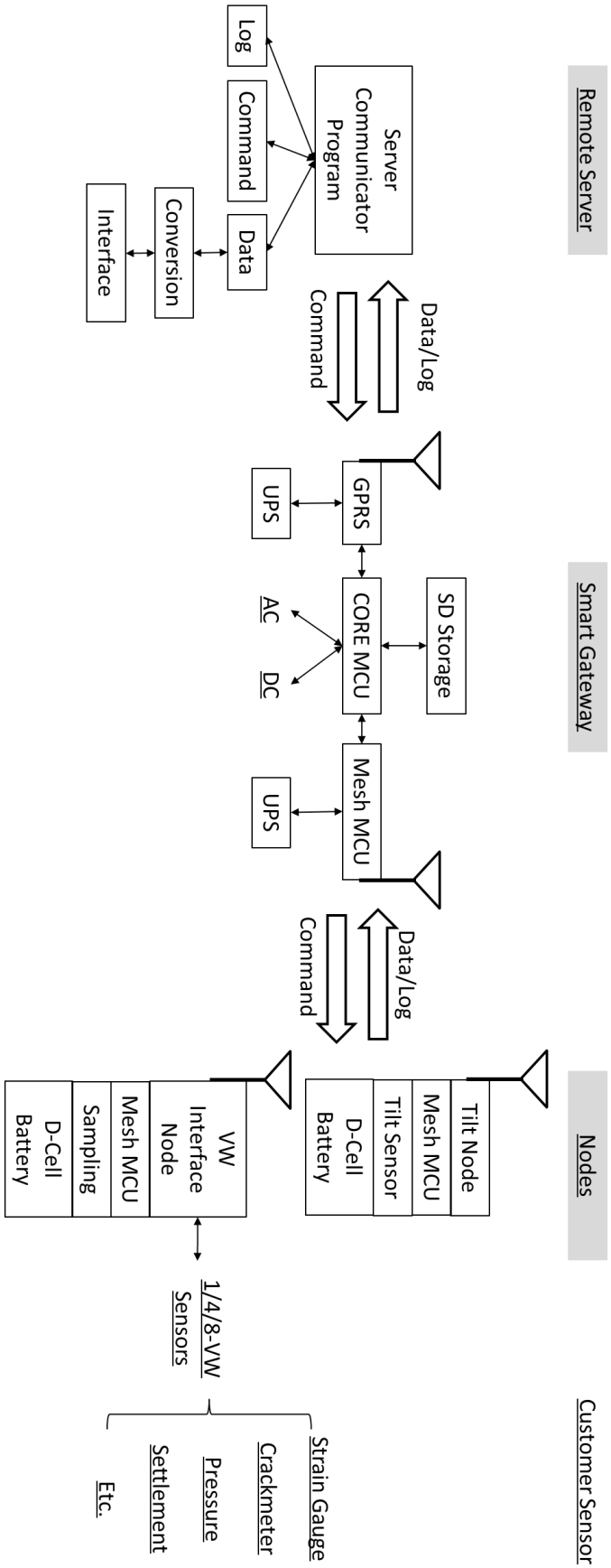
B. Network Data Arrival Rate: to minimise data packet loss;

C. Single Node Environmental Coverage: to maximise radio coverage.

Our product has IP66 and CE marking and is designed to work in a tough environment. It is small in size, reliable in performance, easy for maintenance, has high precision during sampling, and has strong immunity to radio-interference.

Figure 1. Tilt Node Overview in Photos.

2. System Structure Layout



3. Features

WISENMESHNET® Tilt Node @ Typ. 25℃				
	Basics	Power Supply	Qty. x 1 (3.6V D-Cell 32650)	
		Stop/Min. Voltage	2.1VDC	
		Battery Connection	Standard Metal Battery Holder	
		Working Current (DC)	Max. 20mA (Typ.)	
		Operating Temperature	-40℃ to 80℃	
		Storage	300 Messages during Meshing	
		L x W x H	100 x 100 x 60mm	
		Weight	0.8kg	
		Fixing Bracket	Din Rail (Qty. x 2) or Customised Bracket for Angular Surface	
		IP Rating	IP66	
		Certificate	CE	
	Interface	Mesh Wireless Interface	WISENMESHNET® Protocol@250kbps	
		Inspection Period	Every 2 Years	
		Inspection Method	Manufacturer Calibration	
	Sensor	Main Sensor	MEMS Tilt Sensor	
		Parameter	X-axis (or A-axis); Y-axis (or B-axis)	
		Tilt Range	-5° to +5° (or Customised)	
		Accuracy	0.01°	
		Long Term Stability	0.004°	
		Resolution	0.005°	
		Auxiliary Sensor	Temperature	
		Temperature Range	-40 to 80℃	
		Accuracy	0.5℃	
	Radio Parameter	Antenna-2.4GHz	Omni-directional 5dBi (20cm) or Customised	
		Antenna Connect	SMA （Female）	
		Protocol	WISENMESHNET® Protocol / 802.15.4 Compatible	
		Frequency Band	2.405GHz ~ 2.480GHz (16 Channels)	
		Transmit Power	< 1.5dBm	20dBm (Customised)
		Receive Sensitivity	-103dBm	-108dBm (Customised)

WISENMESHNET® - The 3 Fundamental Identities	
Network Life Span	>= 36 months @ Tx power = ~0dBm (typical, 0.5dBm), antenna type 5dBi (omni-directional) @ sampling rate = 10mins
Network Data Arrival Rate	Into WISENMESHNET® greater than 99.5%
Single Node Environmental Coverage	i. Light concrete indoor environment ≥ Approx. 900 square meters ii. Underground tunnel environment ≤ Approx. ±200m (tunnel diameter = 3m, Tx, Rx antenna distance to the wall = 10cm)

4. Tilt Node Terminologies

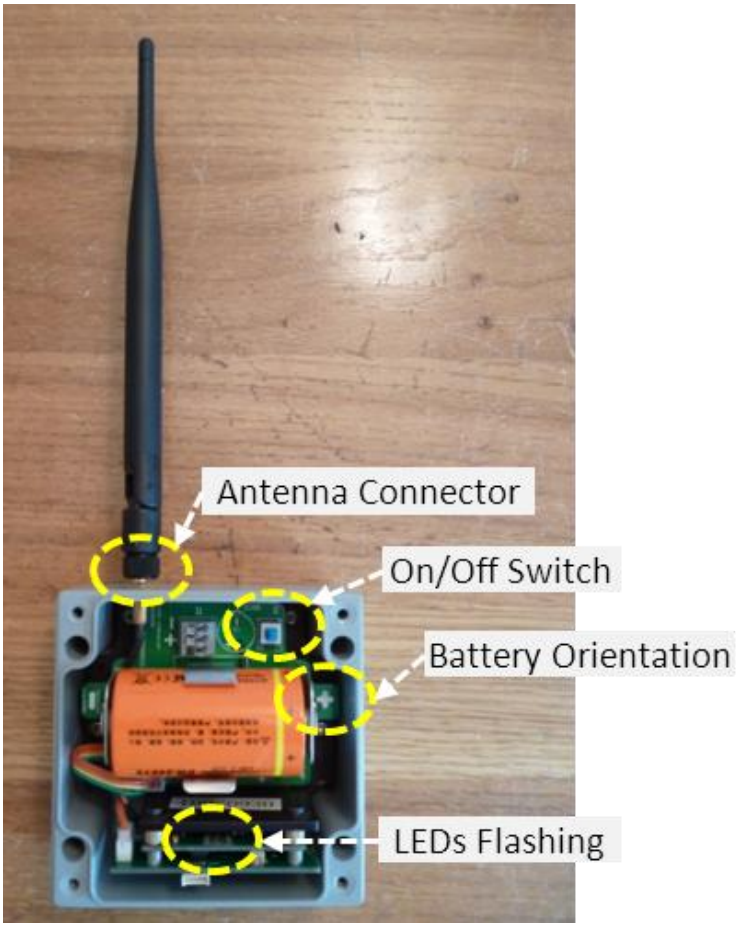


Figure 2. Tilt Node Internal Configuration Terminologies.

5. Operation Procedures

5.1. System Deployment Notifications:

1) Location: The deployment location of a Tilt Node is usually determined by the desired monitoring or inspection location;

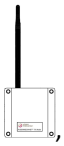
2) Before any Tilt Node is switched on, a gateway must be deployed, powered on and proven to be working properly. Otherwise, the nodes will need to be switched off and on again after a gateway is switched on. So

simply speaking, the rules to follow when deploying and turning on a WISENMESHNET system are:

Gateway first, then nearby nodes, then further nodes.

3) All the tilt node should face to the same direction, and clear notes must be taken so that the tilt direction of a monitored structure can be correctly interpreted;

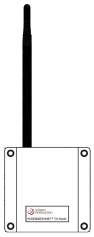
4) The Tilt Nodes have a certain measurement range, please set it up at around 0 degree readings; [Notice: this can be done by two methods, i.e., using a spirit level or using readings from the Tilt Node itself.]

5) All the Tilt Nodes must be oriented upwards, i.e.,  , or ;

6) All the Serial Numbers of the Tilt Nodes must be recorded against their site references.

5.2. Reading Conversion to Structural Tilt Direction

For the Dual-Axis Tilt Node, we define one axis as the “A-axis rotation”, the other as the “B-axis rotation”. To verify the rotational directions according to the data readings on both A and B, please see the table shown below:

Node Orientation	Rotation	Angular Reading (in degrees)
	Clockwise Rotation	On B-axis increases
	Anti-Clockwise Rotation	On B-axis decreases
	Rotating outside the page	On A-axis increases
	Rotating into the page	On A-axis decreases

Or equivalently,

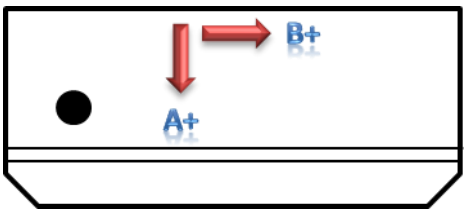


Figure 3. Top Down View of a Tilt Node.

(A+ represents when a Tilt Node is rotating toward the vertical arrow in the figure, the angular reading on the A-axis increases;

B+: represents when a Tilt Node is rotating toward the horizontal arrow in the figure, the angular reading on the B-axis increases)

5.3. Deployment Procedures

1) Open the box: Take the node out of the package and open its lid;

2) Insert Battery: By default, a node does not contain a D-Cell battery. Therefore the battery needs to be inserted.

   Notice: +ve and –ve orientation must be correct, otherwise, the internal circuit may be damaged;

3) Antenna Installation: screw the antenna tightly onto the node;

Figure 4. Mesh Antenna.

4) Power On: switch on the Tilt Node by pressing the square button on the top-right corner. Now you should be able to see 3 LEDs flashing 3 times, this means the node is on. Then switch off the node to save power if the gateway is off;

Figure 5. Battery Installation and Power On/Off Switch (highlighted in yellow circle).

5) To validate the sensor data, and to see it works, please refer to << WISENMESHNET® System Evaluation User Guide >>.

**Notice: To properly deploy a node, you must firstly have a Smart Gateway turned on before a node is powered on. Otherwise, a powered-on isolated node will consume most of its power performing a mesh network searching mode. Therefore battery life is shortened significantly.

5.4. Tilt Node Mounting Options

Notice: There is only one aim while fixing the Tilt Node, that is to make sure that the top/bottom of the node box is horizontal so that the Tilt Node maximum range is not exceeded and so ensuring that optimum readings can be taken in both the A and B axes.

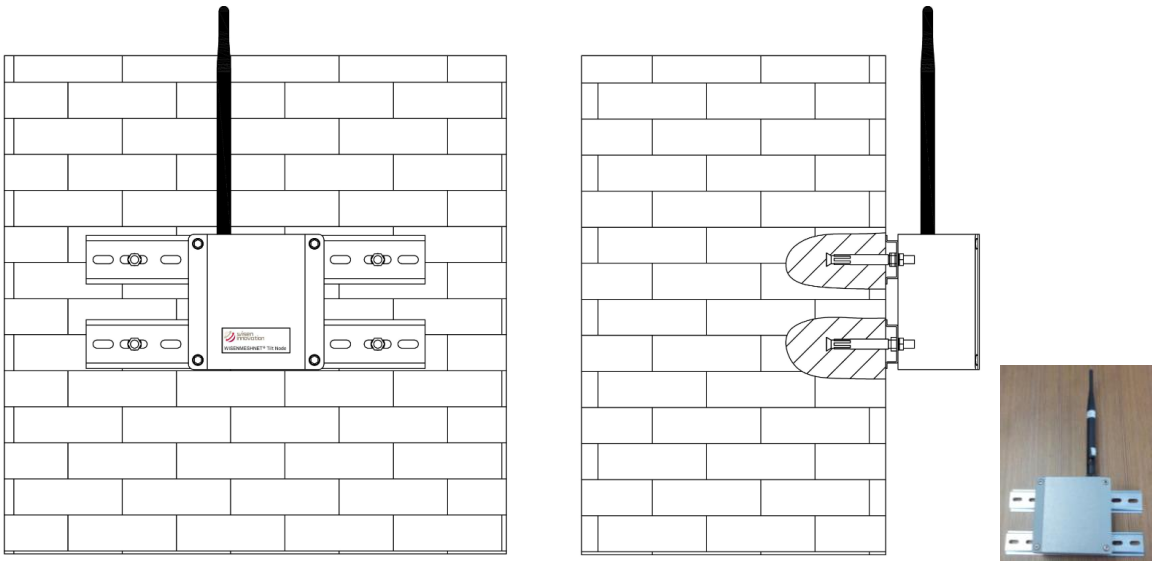
The node fixings must be rigid for the sensor to measure accurate data. Do not use different fixing types, e.g., top and bottom, to avoid thermal effects. Movement in the fixings will affect the readings.

Depending on the installation surface, the Tilt Node can be deployed using two different methods:

1) Flat Surface Fixing using Two Din Rails

Step 1: Cap-Hex-Head Screw M6x14 (Qty. 4) – firmly screw two Din Rails to the back of the node box;

Step 2: Anchor Bolt M6x70 (Qty. 4) (Drill size of M10) – firmly bolt two Din Rails onto the flat surface.



Front View Side View

Figure 6. Surface Fixing – Dual Din Rails.

2) Angular Surface Fixing using One L-Shaped Bracket

Step 1: Screw (NOT tightly) the L-Shaped Bracket onto the back of the node box using Cap-Hex-Head Screws M6x14 (Qty. 4).

Figure 7. WISENMESHNET® Tilt Node onto an L-Shaped Bracket.

Step 2: Bolt the L-Shaped Bracket firmly onto the angular surface using the Anchor Bolts M6x70 (Qty. 4) (Drill size of M10). Level the node using a spirit level attached onto the top of a node, to within 1 degree of horizontal, then tighten all the bolts and screws.

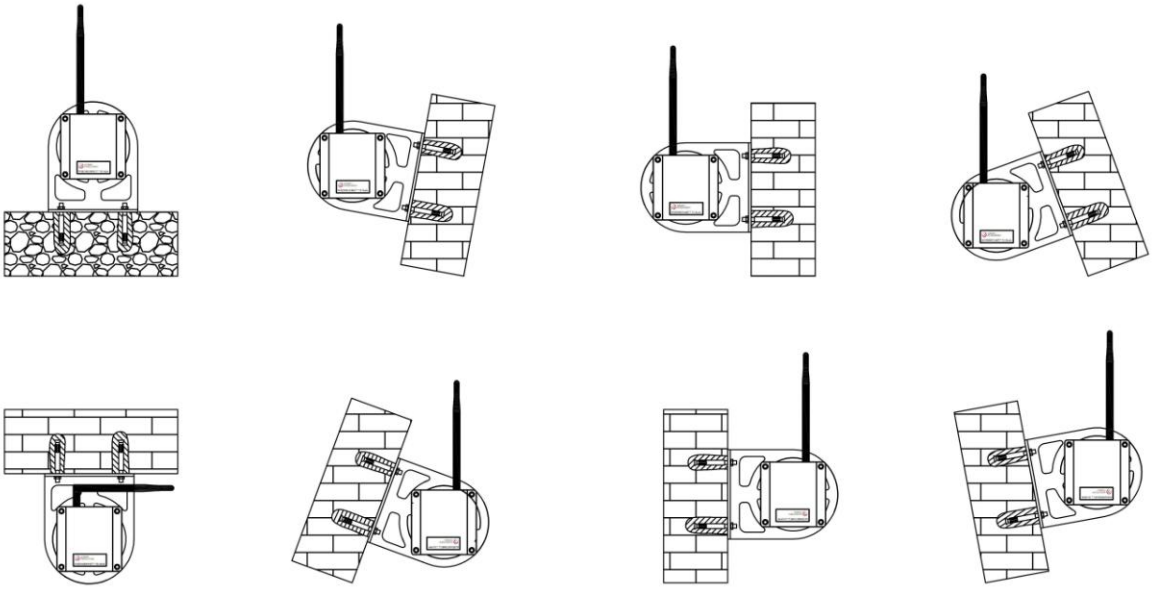
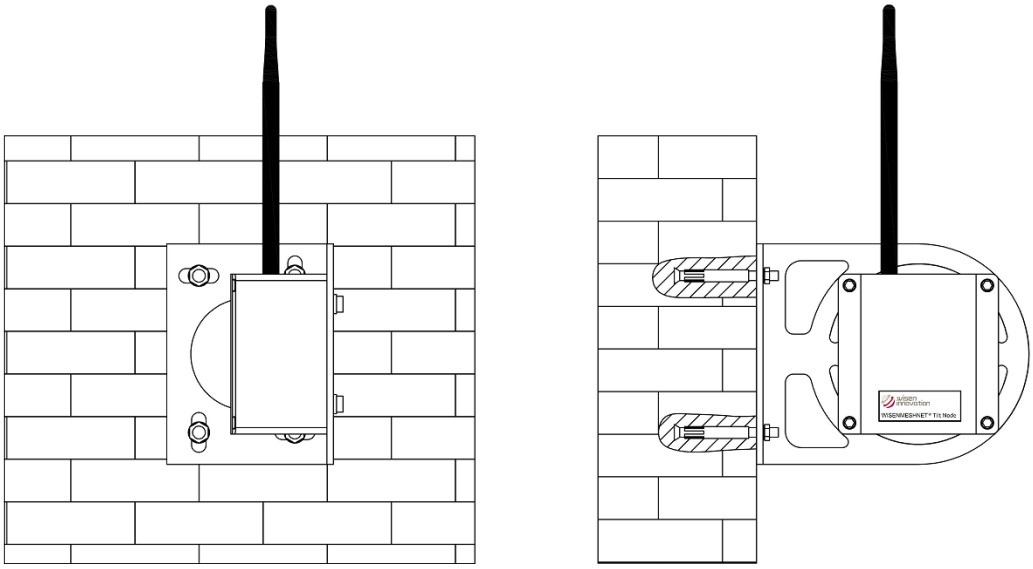


Figure 8. Angular Wall Mounting.



Front View Side View

Figure 9. Angular Wall Mounting on a Vertical Surface Overview.

6. General Maintenance and Notification

1) Once a Tilt Node is installed in the field, please minimise any man-made disturbance so that data quality can be maintained;

2) Radio communication will be impaired if the antenna is covered by metal or very moist soil material;

3) Due to the discharge characteristics of the recommended battery, a battery replacement should be carried out when a node reported voltage reaches 2.7V, at which point you have approximately 3 weeks to change the battery;

4) Our product will use all the possible capacity in a battery down to a stop (minimum) voltage, which has been specified in the Features table. When this occurs, our WISENMESHNET protocol will send you a warning then it will enter a deep sleep mode until a new battery is installed;

5) If the data from nodes are shown unexpected results or are not being sent back to the Wisen gateway, then please carry out investigation using the following two stage procedure:

A. Remote Inspection of historical data, to identify the following:

a) Whether the heart-beat message has been sent back successfully at each time interval;

b) Whether the battery voltage is too low, if yes, please change the battery unit;

c) Whether the signal strength has become significantly weaker than it was previously. If yes, please

check the antenna has been screwed on firmly.

B. On-site Inspection: If all the above are good, please arrange an on-site inspection to check:

a) Whether the Tilt Node has visible external damage;

b) Check the box lid to see if it is firmly tightened;

c) Whether the antenna is bent or damaged and that the node is not blocked by new construction, e.g., hoardings;

d) When it is possible, check that the signal strength is normal by using a spectrum analyser;

e) Open the lid, to see whether the battery is firmly attached to its holder;

f) Use a multi-meter to measure the battery voltage. If it is below the stop (minimum) voltage, replace the battery.

Notices:

i. Case One: If any change has been made from the list above, please inspect the data from the remote server;

ii. Case Two: If all the actions from the list above have not cured the problem, please contact Wisen. We will be happy to help.

7. Package and Accessories

Standard:

No.	Items	Dimension (mm)	Qty.
1	WISENMESHNET® Tilt Node	100x100x60	1
2	User Manual	-	1
3	Inspection Report	-	1
4	2.4GHz 5dBi Omni-directional Antenna	200	1
5	Din Rail	250x35	2
6	Cap-Hex-Head Screw	M6x14	4
7	Anchor Bolt	M6x70	4

Optional/Customer Preparation:

No.	Items	Purpose
1	Angular Bracket	Mounting on an angular surface
2	Battery	For the node
3	M6 Anchor Bolt Spanner	Bolts to the mounting surface
4	M6 Cap-Hex-Head Screwdriver	Screws between din rail and the back of the node box
5	M3 Cap-Hex-Head Screwdriver	Screws on the lid
6	Metal Cable Tie	For special mounting

8. Safety and Warning

Warning: Please read the following instructions carefully.

1）Operation Safety

- Before taking any action, please read all the information provided carefully, and keep the guidance documents safe;
- Ensure that any procedures and installations are correctly carried out. The communication cable and the case must be grounded.
- This product has been designed to meet a certain water-proof level. However, it becomes water vulnerable when the lid is open or if the cable gland has not been sealed properly.

2）Electric Safety

- To install the battery into a holder, please follow the “+” (positive) and “-” (negative) signs in any Wisen product. Wrong orientation of a battery could potential cause unit damage. Notice: The orientation of battery can vary among products.
- When disconnecting the battery, please take special care not to apply excessive force, otherwise the battery holder and the nearby circuitry may be damaged.

3）Warning

- The battery in the product has a relatively high capacity, so please take special care during storage and usage.
- This product must not be disassembled under any circumstances, to do so will void the warranty and may leave the product in a dangerous state;
- If all the above are not followed, the manufacturer cannot be held responsible for any damage and injury caused to the users.

4）Caution

- Danger of explosion if battery is incorrectly replaced. Replace only with the type recommended by the manufacturer.
- When disposing of the batteries, please contact your local authorities or dealer and ask for the correct method of disposal.

9. Contact

- Wisen Innovation Ltd: www.wiseninnovation.co.uk

- Email: enquiries@wiseninnovation.co.uk